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ABSTRACT

This curriculum guide, developed during a pilot project at three sites in Ohio during the 1973-75 period, is designed for the teacher implementing a pre-postsecondary program in engineering careers for eleventh and twelfth grade students. The guide contains an introduction, a section on program philosophy and assumptions, elements of a pre-postsecondary program (including block-time scheduling, simulated activities, field experiences, career guidance, and individualization), plus content outlines and class activities. Activities (intended to take two years) are outlined across the areas of mathematics, science (chemistry and physics), career investigation, and additional topics in a core format designed to enable the student to see the applicability of the topics and concepts and to see the holistic nature of knowledge. The content outline correlates an activity number with a specific topic in one of the major activity areas. (TA)

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ED145209

PRE-POSTSECONDARY PROGRAM

AN ENGINEERING CAREERS CURRICULUM

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INTRODUCTION

OVERVIEW

This curriculum is designed for the teacher implementing a Pre-Postsecondary Program in Health Careers. During the 1973-74 and 1974-75 school years, the Ohio State Department of Education, Division of Vocational Education, conducted a pilot program at three sites in the state (Akron Public Schools, Great Oaks Joint Vocational School District, and Owens Technical College). This curriculum was written during the summer of 1975 and reflects the insights gained in the pilot experience.

The Pre-Postsecondary Program is part of the Career Education thrust in the State of Ohio for 11th and 12th grades. It is intended to be the culmination of a K-12 Career Education Program. At the end of the 10th grade, those students who have chosen to continue their formal education after high school (be that a university, college, community college, technical college, or junior college) enter the Pre-Postsecondary Program. Those students who plan on entering employment right after high school would attend a vocational program.

The 11th grade students entering the program will choose one of four career clusters. These four clusters are Business Administration Careers, Engineering Careers, Health Careers, and Social Science Careers. The clusters provide the student with a variety of options within his or her interest area besides their specific career goal. As an example, often persons entering the health careers field plan on being a doctor. As they get more information about themselves and the medical field in high school and college, they may find that being a doctor was not their best choice. The careers cluster approach will have provided them with vocational options they might not have considered.

It should be noted that this program is not vocational. The career interests of the student are used as a means of better preparing them in the academic areas and assisting them in their career choice. It is intended that this approach assist the student to be more successful in his or her further education.

There are several parts to this curriculum packet. Besides this introductory section, there is a section on philosophy and assumptions, elements of a Pre-Postsecondary Program, field experiences, plus content outlines and class activities. It is the hope of the authors that these materials will be of assistance to a teacher implementing a Pre-Postsecondary Program.

PHILOSOPHY AND ASSUMPTIONS

The Pre-Postsecondary Program centers around two philosophical assumptions. The first is that one of the public school's responsibilities is to help students make good career decisions. Over one fourth of a person's life is spent in working, and a life can be richer and fuller if a career is fulfilling. The second philosophical assumption is that students learn best if their involvement in the learning process is maximized. Students learn best if they are able to apply the knowledge being taught to a laboratory or field experience; they learn best if the knowledge being taught is related to their goals in life (in this case, their career goals).

These assumptions led to the following general aims of the program:

1. The student shall be able to qualify for entrance into a postsecondary educational institution of his or her chosen field.
2. The student will arrive at a better understanding of himself or herself in the following areas:
   a. Aptitudes
   b. Interests
   c. Motivation
   d. Economic, Social, and Personal Values
3. The student shall be able to make a realistic career decision.
4. The student shall be able to plan, analyze, and evaluate his or her educational, occupational, and personal goals and activities.
5. The student shall be able to demonstrate meaningful realtionships between academic knowledge and his or her environment.

COMPONENTS OF THE PRE-POSTSECONDARY PROGRAM

Probably the most unique aspect of the program is in the methodologies utilized. There are several aspects to this dimension.

1. Block Time Scheduling. The Pre-Postsecondary Program should be centered around a three to four and a half hour block of time. The large time block allows the use of experiential methodologies (in-class and out-of-class) significant teacher-pupil interaction, and integration of academic knowledge with the experiential methodologies.

2. Simulated Activities. Within the block of time each student should perform activities that simulate their professional area of interest. These simulated activities become the center of academic subjects using a Core concept. This curriculum consists of these activities along with the academic knowledge that should be integrated with them.

3. Field Experiences. Field experiences are an important component of the Pre-Postsecondary Program, and there is a special section devoted to them later in the introduction.

4. Career Guidance. A major goal of the program is to assist the students in making career and educational choices. The simulated activities and the field experiences obviously give the students the opportunity to know what people in their career area do and also provides the students with other closely related career options. The teacher-pupil interaction provided by the block time is also a significant factor. Vocational interest surveys, value clarification exercises, and career exploration research reports should also be used.

5. Individualization. As much as possible, the Pre-Postsecondary Program should be directed toward individual needs, interests, and aptitudes. Allowing the students to choose the career cluster of interest to them is a start in

the direction of individualization, and the block of time gives the teacher time to get to know the student so he or she can better meet the needs, interests and abilities of the students.

FIELD EXPERIENCES

Field experiences are an important ingredient to the Pre-Postsecondary Program. All of the pilot programs did include community work for the pupils, and both teachers and students considered them significant in the success of their programs. Based on the experiences of the pilot programs, the following recommendations are included:

1. Nature of Field Experiences. During the first half of the junior year, student visitations should be made to many different kinds of places employing people in the broad career field. This is to assist the student in seeing the many options available in their chosen area. This can be done as a class, on a small group basis, or as individuals. In the second half of the junior year, the visitations should be narrowed to the individual interests, needs, and capabilities of the students. It may be that during this time the student will visit several places that employ people in his or her chosen career or in closely related careers. Naturally these visits would be on a small group or individual basis. The field experiences in the senior year should consist of the student actually working one day a week in his or her chosen area. Ideally, the student should work in three different "jobs" during the year. It is important that the student be able to experientially explore more than one field but, on the other hand, spend several weeks in one place to get some competence and to get a feel for the routine involved in their chosen career.

2. Student Accountability. It is necessary to make the student accountable in their field experiences work for two reasons. The first is to provide the student with maximum benefit. The second reason is that the procurement of locations to place students is much easier when those working at the locations realize that this work will be taken seriously (i.e., good quality of work and regular attendance) by the students. In the pilot programs, the staff members

seeking positions for thestudents in the senior year found some resistance in the beginning, but after the students had started their work, in almost all cases, the people supervising and working with the students wanted more people assigned to their location. Student accountability was an important factor.

3. Debriefing. Within a day or two after the field experience there should be some form of debriefing. At least three topics should be discussed. First, it should be determined if there were any problems in arrangements. Secondly, there should be discussion about what was observed so that other students could benefit from the experience. The third area of discussion in the debriefing session should deal with how the students related the experience to their personal lives. This should center on interests, capabilities, values, and feelings. Books on value clarification and confluent education could be used by the teacher for help with this aspect of the program.

4. Making the arrangements. Making the arrangements for the field experiences is a time consuming job, and staffing needs to be planned with this factor in mind. Although a field experience coordinator was hired in one of the pilot programs, it was felt by those involved that the teacher is the best person to make the arrangements and should be given time for this task. The reasons for selecting the teacher is that he or she should know the students best, is best able to relate academic subjects to the field experiences, and is better able to know on a day to day basis what is happening in the field because of the contact with the students.

It was found that there were several sources of field experiences. Professional societies and local institutions are rather obvious sources. An advisory committee can be of help and should be selected partially because of the assistance it can give in this area. Parents, other family members, and

friends of the student were also valuable in locating field experiences.

The arrangements for the visitations in the senior year need to be made well in advance. The experiences from the past two years would indicate that these arrangements are best made during the summer before the senior year, and that the teacher(s) should be given an extended contract to do this work.

5. Transportation. Transportation was a recurring problem in all of the programs and needs to be thought through in advance. Ideally, transportation, especially when the field experiences are on an individual or small group basis, should be left up to the students. Car pools with parents or students driving could be formed or students could drive their own cars. Vans were used by two of the pilot programs but do present time problems if the individual or small group field experiences are too spread out geographically.

Two other factors that need consideration are the safety of the students and personal liability with field trips. Because the students and parents will also become liable in the field experience program if they transport other students, it is important that a study be made of the applicable law and that all involved understand the extent of their liability and protection. An insurance policy which can be obtained at a minimal cost per person would be a benefit to all involved.

THE CURRICULUM

GETTING READY TO TEACH

The most important step in the preparation of a lesson is for the teacher to make specific plans. Prepared materials are not intended to take the place of this step. Within the planning step, the preparation of instructional objectives is of major significance. The teacher should then make a time outline of what is going to be done in the class session. Obviously this outline should be flexible. The last step in the preparation is to make a complete list of materials and equipment needed and to procure these items before the class session.

In this planning step, there are several factors that should be kept in mind. The first is that the activity is the center of any lesson; it is the means of motivating the students and the means of assisting the students to apply the academic knowledge. Many different strategies may be used to teach the academic material (e.g., discussion, lecture, group work, reading assignment), but these should always be used as they can be related to the central activity. Also there will probably be more than one activity being done at a time by a class. Some of the activities can be completed in a short time, others take several weeks.

Although evaluation is not considered in this guide, it is a necessary step in the lesson preparation. It is imperative that evaluation procedures be logically consistant with the instructional objectives. Also, the evaluation should be viewed as primarily diagnostic for both the teacher and student. For the teacher evaluation is a means of diagnosing the success of a lesson or a series of lessons. For the student, the evaluation is a means of determining strengths and of determining areas that require further work. It is not the primary purpose of evaluation to produce grades.

INTRODUCTION TO THE CURRICULUM FOREMAT

There are several parts to this section. First, there are content outlines. In the column to the right of the topics and concepts are numbers designating which activities include the topic or concept. The content outline is followed by the activity charts. At the top of the chart is the objective for that activity. Below the objective are five columns. In the far left column is the activity. The other four columns include the concepts and knowledge to be taught with that activity.

It is intended that the concepts be taught in conjunction with the activities. The teacher will have to make the decision as to whether a particular concept needs to be taught before the activity is done, during the work on the activity, or after the activity has been completed. Some concerns the teacher should have in making this decision are, (1) how necessary the knowledge is in starting the activity, (2) how much the student already knows, and (3) how important the motivation provided by the activity is.

Any methodology, no matter how good, if it becomes routine, will lose its "punch". Therefore it becomes necessary to use variety and imagination in the teaching of the academic concepts and topics. Buzz groups, class discussion, films, short research projects, class presentations are among the many teaching strategies that can be used.

Among the reasons for putting the material in the Core format is to enable the student to see the applicability of the topics and concepts, and to see the holistic nature of knowledge. These emphases should be kept in mind by the teacher in planning and should be pointed out to the students.

The activities are intended to take two years. Although the author has put the activities in a suggested order, it is assumed that the teacher will have the prerogative to change the order to fit his or her particular situation and class.

Content Outline

Mathematics	Activity Number
1. The real number system	1,2
2. Fundamental laws of algebra	1,2
3. Functions	5
4. Graphs	4,8
5. Ratio, proportion and variation	3,6,8,11
6. Linear equations	3,6,8,11
7. Systems of simultaneous linear equations	3,6
8. Matrices and determinants	6
9. Exponentials	8
10. Logarithum	6,8,11
11. Permutations and combinations	15
12. Probability	15,43
13. Descriptive statistics	15,43
14. Factoring polynomials	6,8
15. Fractional equations	3,8
16. Quadratic equations	5,6,8
17. Non-linear systems of equations	6
18. Geometry of circles and triangles	3
19. Circular functions	3
20. Trigonmetric functions	3,8,12
21. Trigonometric equations and identities	3,4,6
22. Graphs of trigonometric functions	4,6,8,11
23. Polar coordinates	28
24. Inverse functions	3
25. Vectors	3,4,5

Mathematics (continued)	Activity Number
26. Complex Numbers	11
27. Sequences and series	
28. Theory of equations	6
29. Inequalities and linear programming	6
30. Analytic geometry - lines, circles, parabolus, etc.	3
31. Regression and curve fitting	

Chemistry	Activity Number
1. Atomic structure	12
2. Electron configuration	12
3. The periodic table	8
4. Chemical bonds	6
5. Chemical compositions	6
6. Chemical equations	6,8
7. The gas laws	5
8. Molecular composition of gases	9
9. Physical states of matter - phase changes	7,41
10. Process of solution	6,41
11. Ionization	40
12. Acids, bases and salts	6,8,41
13. Suspensions	6
14. Carbon and its oxides	9,43
15. Hydrocarbons	7,9,43
16. Natural organic compounds	43
17. Chemical kinetics	6,45
18. Chemical equilibrium	6,45
19. Oxidation-reduction reactions	6
20. Properties of elements and groups	
a. Metals - Groups I and II	16
b. Transition elements	16
c. Aluminum and semiconductors - Groups III and IV	11
d. Nitrogen family - Group V	9
e. Sulfur family - Group VI	9
f. The Halogens - Group VII	6
g. The noble gases - Group VIII	5

(Based on Modern Chemistry by Metcalfe, Williams and Castka. Published by Holt, Rinehart and Winston, Inc., 1970)

Physics	Activity Number
1. International System of Units	2,11
2. Measurements - accuracy and precision	2
3. Mathematics of measurement	2,11
4. Measuring forces	3,4
5. Resolution of forces	3,4
6. Composition of forces	4
7. Friction	5
8. Parallel forces	3
9. Velocity	4,5
10. Momentum	5
11. Acceleration	4,5
12. Newton's Laws of Motion	5
13. Gravitation	6,44
14. Circular motion - orbits	17,44
15. Rotary motion	4
16. Simple harmonic motion	4
17. Work and power	6
18. Energy	6
19. Efficiency	6
20. Kinetic theory of matter	
a. Solids - tensile strength, ductility, elasticity, etc.	6,16
b. Liquids - capillarity, fusion, surface tension, etc.	8
c. Gases	5,40
21. Fluid statics	5,6
22. Fluid dynamics	6
23. Temperature and heat measurement	6
24. Thermal expansion	6

Physics (continued)	Activity Number
25. Change of phase	6
26. Heat and work	6
27. The nature of waves	11
28. Wave interactions	11
29. The nature of sound	11
30. Waves and particles	12,13
31. Illumination	8
32. Reflection	3
33. Refraction	3
34. Lens optics	3
35. Dispersion	12
36. Interference and diffraction	12
37. Polarization	12
38. Electric charge	8
39. Potential difference	8
40. Sources of direct current	8
41. Series and parallel circuits	8
42. Heating effects of electricity	8
43. Electrolysis	40
44. Magnetism	8
45. Electromagnetism	8
46. Induced currents	8
47. Generators and motors	6,8
49. AC circuits	11
50. Resonance	11
51. Electronic devices - tubes and semiconductors	11

Physics (continued)	Activity Number
52. The nucleus	15
53. Nuclear reactions	15
54. Uses of nuclear energy	15
55. Elementary particles	15

NOTES ON THE PRE-POSTSECONDARY ENGINEERING CURRICULUM

1. Although many of the activities specify either design or construct, the ideal would be to include construction of at least a working model with each major activity. However, model construction can become costly and may be beyond the budgets of most school systems. It is, therefore, expected that the individual teacher will choose the design and/or construct mode for each activity. However, concentration solely on the design mode will negate some of the potential of the curriculum to give students a "hands on" experience.
2. The content listed with each activity represents content which is specifically applicable to that activity. At times the content coverage may occur simultaneously with the activity; at other times the nature of the activity and associated content may be such that content coverage may precede the activity. The individual teacher will have to decide the technique that works best for him/her.
3. The curriculum guide math content was restricted to those topics clearly required to complete the activity. In many of the activities, for the second year especially, the math topics may have been presented in sufficient detail earlier so that repetition may be unnecessary. The individual teacher may then choose to introduce additional topics from what might be called pre-calculus or advanced algebra. Calculus has been intentionally excluded from the curriculum so that algebra-trigonometric fundamentals can be stressed, thus ensuring sufficient math background so that the student will be successful in his/her postsecondary math-science-engineering courses (be they algebra or calculus based).

4. Activities numbered 1 to 18 were prepared to be done approximately sequentially during the two years of the program. The order is not mandatory, however, some content may have to be changed to include prerequisite material if a different order is desirable. The activities numbered 19 and following should be interspersed with the activities 1 to 18 as the teacher sees fit. Some of these latter activities are associated closely with other activities--these activites have been so identified with a time notation.

OBJECTIVE: The student will be able to use various calculating devices to perform routine arithmetic operations encountered in engineering calculations.

1 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Use various calculating devices (i.e. slide rule, nomograms, electronic calculators) to perform routine arithmetic calculations, including chained operations.	Algebra 1. Scientific Notation 2. Significant Figures 3. Combining Experiments 4. Commutative Law (+ & X) 5. Associative Law (+ & X) 6. Distributive Law 7. Operations with signed numbers and zero 8. Approximation techniques 9. Round off errors		Engineering	

OBJECTIVE:
1. The student will be able to use various devices to perform routine mechanical measurements.
2. The student will be able to record measured quantities properly, taking care with significant figures and precision.
3. The student will be come familiar with SI units of measurement.

2 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Measure the linear dimensions, volume, surface area, mass density, etc., of various metal rods, bars, plates, etc., using a number of different instruments (e.g., tapes, micrometers, vernier calipers, depth mikes) Instruments should be primarily SI (metric) although some English measurements will allow comparisons.	1. Scientific Notation 2. Rules for Exponents 3. Metric Prefixes 4. Significant Figures in Calculations	1. SI Units of Measurement 2. Precision in Measurement 3. Recording Measurements properly - significant figures, units, etc. 4. Weight and Mass 5. Dimensional Analysis	All Engineering Disciplines	The Use of: Micrometers Vernier Calipers Depth Mikes Gauge Blocks Scales Balances

OBJECTIVE: The student will be able to apply the rules of geometric optics to reflective systems.

3A ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design and build a reflecting telescope. Determine the desired characteristics of the mirror - then buy or grind to these specifications.	Algebra 1. Fractional Equations 2. Solving Fractional Equations 3. Angular Measure-Degrees and radius	Physics 1. Laws of Reflection 2. Regular and Diffused Reflection 3. Flat Mirrors 4. Images-Virtual 5. Curved Mirrors 6. Images-Virtual 7. Mirror Formula 8. Constructing Ray Diagrams 9. Spherical Aberration	Optical Engineering Optical Model Maker Optical Technician Optical Glass Silverer	Drafting 1. Constructing Perpendiculars to a Surface 2. Constructing Equal Angles 3. Constructing the Tangent to a Circl 4. Constructing the Tangent to a Circl 5. Constructing a Parabola

OBJECTIVE: The student will be able to apply the rules of geometric optics to refractive systems.

3B ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design the eyepiece, acquire the required components, and construct the eyepiece.	Trigonometry 1. The Trigcnometric Functions of Numbers 2. The Trigonometric Functions of Angles	Physics 1. Index of Refraction 2. Angle of Refraction 3. Laws of Refraction 4. Critical Angle 5. Total Internal Reflection 6. Lens-Convex and Concave 7. Ray Diagrams 8. Lens Equation	Optical Engineering Optical Model Maker Optical Technician	Specification Writing Reading Catalog Specifications Quotation Requests

OBJECTIVE: The student will be able to apply basic equilibrium of forces principles to a simple mechanical system.

3C ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design and build a reflecting telescope. Design and construct the mechanical mount for the optical components.	Algebra 1. Vector components 2. Trigonometric Equations 3. Simultaneous Linear Equations	Physics 1. Vector Forces 2. Moments 3. Center of Mass 4. Rotational Equilibrium	Mechanical Engineering Optical Technician	Drafting

OBJECTIVE:
1. The student will be able to apply equilibrium principles in the design of a mechanical structure.
2. The student will be able to apply the principles of periodic motion to a mechanically oscillating system.

4 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design a playground swing and construct a working scale model. Things to consider: 1. Swing Period 2. Swing must Remain Upright 3. Who will Use it? 4. How Strong Must the Supporting Ropes, Chains, etc., be?	Algebra 1. Vector Components 2. Trigonometric Equations 3. Graphs of Trigonometric Functions	Physics 1. Vector Forces 2. Moments of Forces 3. Equilibrium - Translational and Rotational 4. Equilibrium - Stable, Unstable, and Neutral 5. Periodic Motion 6. Simple Pendulum 7. Physical Pendulum 8. Centripetal Force 9. Tensile Strength 10. Basics of Displacement, Velocity and Acceleration	Mechanical Engineering Toy Designer	Drafting

OBJECTIVE: The student will be able to make a design choice based on his/her knowledge of the physical principles involved.

5A ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design a lighter than air craft. Determine the size, shape, bouyant gas, desired load, etc. (It would be good to review the literature on these air craft at this point).	Algebra 1. Ratio and Proportion	Physics 1. Mass Density 2. Archimede's Principle 3. Boyle's Law 4. Charles' Law Chemistry 1. Hydrogen 2. Helium and Other Noble Gases	Aeronautical Engineering Mechanical Engineering	Literature Search

OBJECTIVE: The student will be able to apply Newton's Laws to a physical system.

5B ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design a lighter than air craft. Determine the requirements for a propulsion system based on desired speed, size limitations, weight limitations, etc.	Algebra 1. Vector Components 2. Vector Addition 3. Multiplication by a Scaler 4. Quadratic Equations 5. Functions	Physics 1. Scaler Quantities a. Distance b. Speed 2. Vector Quantities a. Displacement b. Velocity c. Acceleration 3. $\vec{F} = m\vec{a}$ 4. Potential Energy 5. Kinetic Energy 6. Momentum 7. Conservation of Energy 8. Conservation of Momentum	Aeronautical Engineering Mechanical Engineering	Sir Isaac Newton

OBJECTIVE: The student will be able to apply his/her knowledge of hydrostatics to a physical system.

6A ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design an above-ground swimming pool. Determine the construction requirements for walls and bottom after deciding on such things as shape, size, depth, etc.	Algebra 1. Linear Equations	Physics 1. Hydrostatic Pressure 2. Pressure vs. Force Chemistry 1. Water 2. Reactions with Construction Materials 3. Paints and Other Coatings Engineering Science 1. Properties of Materials 2. Joints-Bolts, Rivets, Welds	Civil Engineering Metallurgical Engineering Chemical Engineering	Investigate Local Building Code requirements for swimming pools

OBJECTIVE: The student will be able to apply the principles of fluid dynamics to a physical system.
The student will be able to write specifications for the components of a system.

6B ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design an above-ground swimming pool. Determine the requirements for the pool filtration system, then determine the components required to achieve the desired results.	Algebra 1. Quadraic Equations	Physics 1. Fluid Dynamics 2. Bernoulli's Equation 3. Viscosity 4. Turbulance 5. Power 6. Energy Losses 7. Efficiency 8. Evaporation Engineering Science 1. Pipes 2. Electric Motors 3. Pumps Chemistry 1. Colloids 2. Precipitates 3. Solutions	Environmental Engineer Mechanical Engineering Electrical Engineer	Specification Writing

OBJECTIVE: The student will be able to apply his/her knowledge to chemistry of water and halogens to a physical system.

6C ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design an above-ground swimming pool. Determine the chemical requirements for keeping the pool algae-free and the bacteria count low.	Algebra 1. Ratio 2. Proportion 3. Logarithms	Chemistry 1. Water 2. Halogens 3. pH Biology 1. Algae 2. Bacteria	Chemical Engineering Environmental Engineering	Code requirements for safe operation of swimming pools.

OBJECTIVE: The student will be able to apply the principles of heat and temperature to a complex physical system.

6D ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design an above-ground swimming pool. Determine the requirements for a pool heating system if the pool is to be available for use from April-October. Consider heat losses through evaporation, conduction through walls, radiation from walls, addition of "new" well water, etc.	Algebra 1. Ratios 2. Linear Equations 3. Quadratic and Higher Order Equations	Physics 1. Specific Heat 2. Cooling by Evaporation 3. Calories and BTU'S 4. Heat Conduction 5. Heat Radiation 6. Electric Heating 7. Efficiency 8. Temperature 9. Expansion Chemistry 1. Heats of Combustion 2. Heats of Vaporization Engineering Science 1. Furnaces 2. Water Heating Systems 3. Energy Conversion Efficiency	Mechanical Engineering Chemical Engineering	Temperature Variations in the Area Costs of Various Heating Methods Electric, Oil, Gas, etc. Code Requirements

OBJECTIVE: The student will be able to apply the principles of conservation of energy to an elastic system.

The student will be able to relate design requirements to manufacturers specifications.

6E ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design an above-ground swimming pool. Determine the requirements for the diving board, then identify an available board which meets those requirements.	Algebra 1. Trigonometric Equations 2. Graphs of Trig Functions 3. Simultaneous Equations Determinants	Physics 1. Periodic Motion 2. Elasticity 3. Moments of Forces 4. Gravity 5. Projectile Motion 6. Conservation of Energy 7. Equilibrium 8. Hooke's Law 9. Center of Mass Engineering Science 1. Properties of Materials: Wood Fiberglass Plastics 2. Bending Stresses	Mechanical Engineering Metallurgical Engineering	Reading Design Specifications Prepared by a Manufacturer

OBJECTIVE: The student will be able to develop a construction schedule.

6F ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design an above-ground swimming pool. Set up a construction schedule, estimate costs, etc.	Algebra 1. Inequalities 2. Linear Programming		Industrial Engineering Estimator	

OBJECTIVE: The student will be able to apply his/her knowledge of hydrocarbon chemistry to a production problem.

The student will be able to describe the techniques used to produce petroleum products from crude oil.

7 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Report on the different refining techniques, i.e., catalytic cracker, cracking tower, etc., used in the production of petroleum products.		Chemistry 1. Hydrocarbons 2. Catalysts 3. Phase changes	Chemical Engineering	Refinery Operation

OBJECTIVE: The student will be able to read a schematic diagram.

8A ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Analyze an automobile electrical system. Obtain the schematic diagrams for the automobiles chosen. Identify the major divisions in the electrical system - ignition system, lights, heating/cooling, etc.			Mechanical Engineering Electrical Engineering	Reading Schematic Diagrams

OBJECTIVE: The student will be able to apply his/her knowledge of chemistry and physics to a standard electric power source.

8B ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Analyze an automobile electrical system. Determine the operating characteristics of the lead-acid storage battery-open circuit emf, capacity in amp-hours, internal resistance.	Algebra 1. Ratios 2. Linear Equations 3. Graphing Linear Data 4. Quadratic Equations	Chemistry 1. Balancing Equations 2. Electronegativity 3. Lead 4. H_2SO_4 Physics -DC Electricity 1. Voltage 2. Current 3. Resistance 4. Energy 5. Power 6. Internal Resistance 7. Charging Batteries	Electrical Engineering Chemical Engineering	VOM'S VTVM'S Oscilloscopes

OBJECTIVE: The student will be able to apply his/her knowledge of electro-magnetism to an operating electro-mechanical device.

8C ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Analyze an automobile electrical system. Determine the operating characteristics of the alternator/generator-output voltage, current limits, etc.	Trigonometry 1. Trigonometric Functions 2. Graphs of trig Functions	Physics 1. Magnetic Fields 2. Electromagnetic Induction 3. Alternating Current 4. RMS Values 5. Rectifiers 6. Filters 7. Ripple	Electrical Engineering	Making AC Measurement

OBJECTIVE: The student will be able to apply the principles of DC electricity to a real world system.

8D ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Analyze an automobile electrical system. Investigate the characteristics of the lighting system.	Algebra 1. Fractional Equations	Physics 1. Direct Current Quantities 2. Power 3. Series Resistance 4. Parallel Resistance 5. Light Production 6. Illumination	Electrical Engineering	

OBJECTIVE: The student will be able to apply the principles of electricity to a practical system.

8E ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Analyze an automobile electrical system. Investigate the ignition system. (The Physics of Technology module, Automobile Ignition System published by the McGraw Hill Book Company is an excellent source for this activity.)	Algebra 1. Natural logarithms 2. e and powers of e	Physics 1. Rotational Kinematics 2. Dielectric Breakdown (air) 3. Induction 4. Capacitance 5. Time constants	Electrical Engineering	Use of the Oscilloscope

OBJECTIVE: The student will be able to develop a sampling and analysis procedure.

The student will be able to apply his/her knowledge of hydrocarbon chemistry to a practical situation.

9 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Analyze the emissions from an automobile		Chemistry 1. Combustion 2. Hydrocarbons 3. Sulfur 4. Nitrogen 5. Analytical Techniques 6. Temperature Effects on Combustion Products Engineering Science 1. Sample Techniques 2. Collection Methods	Chemical Engineering Environmental Engineering	Current and Proposed E.P.A. Standards E.P.A. Prescribed Testing Methods

OBJECTIVE: The student will develop an awareness of alternative energy sources.

10 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Report on alternatives to internal combustion engines for automobiles. (Scientific American is a good source)		Chemistry-Physics 1. Batteries 2. Fuel Cells 3. High Energy Fly-Wheels 4. Fuel Cell 5. Solar Cells 6. Nuclear Energy	Automotive Engineering Chemical Engineering Mechanical Engineering Electrical Engineering	E.P.A. Regulations

OBJECTIVE: The student will be able to read the schematic diagram of an electronic device.

11A ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Build a radio from a schematic diagram. Obtain the schematic for a simple AM radio, collect the required components after studying the schematic. (This should preferably be a transistorized model)	Algebra 1. Scientific Notation 2. Metric Prefixer	Physics 1. Electrical Components 2. Color Codes 3. SI Units of Electricity		Reading Schematic Using VOM'S and VTVM'S

OBJECTIVE: The student will be able to apply the principles of electricity to a practical system.

11B ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Build a radio from the schematic diagram. Construct the power supply section - investigate the output characteristics, i.e., voltage, current, ripple, etc.	Algebra 1. Linear Equations 2. Ratios Trigonometry 1. Sine Waves 2. Adding and Subtracting Functions	Physics-Electricity 1. Transformers 2. Rectifiers 3. Filters 4. Ripple	Electronic Engineer and Technician Electrical Engineer and Technician	Using the Oscilloscope

OBJECTIVE: The student will be able to apply the principles of electronic devices to an operating circuit.

11C ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Build a radio from the schematic diagram. Construct the amplifier section and investigate its characteristics, i.e., gain, frequency responces, etc.	Algebra 1. Logarithms	Physics-Electricity 1. Vacuum Tubes 2. Transistors 3. Load Lines 4. Characteristic Curves 5. Biasing 6. Gain (dB) Chemistry 1. Semiconductors-Si and Ge	Electronic Engineer	FCC Regulation

OBJECTIVE: The student will be able to apply the principles of resonance to a practical circuit.

11D ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Build a radio from the schematic diagram. Construct the tuning circuit and investigate its characteristics, i.e., resonant frequency, bandwidth.	Algebra 1. Solutions of Equations Involving Radicals	Physics-Electricity 1. RLC Circuits 2. Resonance 3. Bandwidth 4. Q of a circuit	Electronic Engineering	

OBJECTIVE: The student will be able to apply his/her knowledge of sound to a physical system.

11E ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Build a radio from the schematic diagram. Construct the speaker section and investigate the audio output characteristics.	Algebra 1. Logarithms 2. Ratios	Physics 1. Electrical Power 2. Measuring Sound Levels (dB) 3. Isolation Transformers 4. Power-peak-to-peak, rms, average, etc? 5. Efficiency 6. Sound Production	Audio Engineering Electronic Engineering	

OBJECTIVE: The student will be able to apply the rules of physical optics to a simple optical system.

12 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Construct a cigar-box spectroscope and use it to analyze the optical spectra of various gases.	Trigonometric Functions	Physics 1. Electronic Energy Levels and Transitions 2. Particles and Waves 3. The Electro-magnetic Spectrum 4. Dispersion	Chemical Engineering Optical Engineering	

OBJECTIVE: The student will become familiar with various techniques for direct conversion of sunlight to useful energy.

13 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design and build a solar energy collector. Investigate the pros and cons of various techniques, i.e., photocells, heat collectors, etc. (Scientific American is a good source)		Physics-Chemistry 1. Photo-Electric Effect 2. Heat Absorption 3. Solar Furnace (i.e., reflector) 4. Energy Storage	Power Engineering Electrical Engineering Mechanical Engineering	Economics

OBJECTIVE: The student will be able to describe the operation of a fossil fuel power plant.

14 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Construct a model of an electrical power plant utilizing fossil fuel as the power source.		Chemistry 1. Carbon 2. Hydrocarbons 3. Combustion Physics 1. Generators 2. Heat Transfer 3. Turbines	Chemical Engineering Electrical Engineering	Fuel Costs

OBJECTIVE: The student will be able to describe the operation of a nulear power plant.

15 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Construct a model of an electrical power plant utilizing nuclear energy as the power source.	Probability and Statistics 1. Permutations and Combinations 2. Probability 3. Statistics	Physics 1. The nucleus 2. Nuclear Reactions 3. Heat Transfer 4. Radiation Effects on the Body	Nuclear Engineering Electrical Engineering	NRC (Nuclear Regulatory Commission) Regulations Reactor Types (BWR, PWR LMFBR, HGTR, etc.) Fuel Costs Nuclear Safety

OBJECTIVE: The student will be able to describe processes for extracting metals from ores.

16 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Write a report on various methods if obtaining metals from ores. Possibly construct a model facility.		Chemistry 1. Group I 2. Group II 3. Transition Elements Physics 1. Change of Phase 2. Kinetic Theory of Solids	Metallurgical Engineering Chemical Engineering	Abundance of Materials

OBJECTIVE:

17 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Design and build a model rocket.		Physics 1. Orbital Mechanics 2. $\vec{F} = m\vec{a}$ 3. $\vec{s}$, $\vec{v}$ and $\vec{a}$	Aeronautical Engineering Aerospace Engineering	History of Space Flight

OBJECTIVE: The student will be able to apply his/her knowledge to a complex engineering system. The student will be able to work with a team, interacting with other teams.

18 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Build a Model Draw-Bridge This activity should be broken up into a number of projects, each project being assigned to a team of students interested in that particular aspect of engineering. The model should be constructed for a specific real location, and should be designed to carry both pedestrian and vehicular traffic. Time: Latter Part of Senior Year	Algebra Trigonometry	Physics Chemistry Engineering Science	Mechanical Engineer Civil Engineer Electrical Engineer Industrial Engineer Metallurgical Engineer	

OBJECTIVE: The student will be able to use his/her knowledge of mechnical systems to make a design choice.

18A ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Determine the best type bridge for the location--e.g., will the center section lift straight up? Will two hinged spans work better? Would a rotating center span be best, etc.			Civil Engineering Mechanical Engineering	Traffic Analysis

OBJECTIVE: The student will be able to apply his/her knowledge to a land acquisition problem.

18B ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Determine land requirements for the approaches and calculate costs of acquiring the property.			Civil Engineering Surveying	Real Estate Prices

OBJECTIVE: The student will become aware of the complex socio-economic problems involved in a large scale project.

18C ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Investigate the socio-economic impact of the bridge on the community in terms of displaced homes, ease of access to formerly less accessible areas, etc. (The whole group should take part in this activity)			All Engineering	Economics Environmental Impact Statements

OBJECTIVE: The studentwill be able to apply his/her knowledge of soil mechanics to an engineering problem.

18D ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Determine the foundation requirements and choose the best type for the location.		Soil Mechanics	Civil Engineering Construction Engineering	

OBJECTIVE: The student will be able to apply his/her knowledge of chemistry to a construction problem.

18E ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Analyze the river water and air quality to determine any special precautions which must be taken to protect the construction materials.		Chemistry	Chemical Engineering	

OBJECTIVE: The student will be able to apply his/her knowledge of statics to a ccnstruction problem.

18F ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Determine the structural design of the bridge.		Physics Statics	Mechnical Engineering Civil Engineering	

OBJECTIVE: The student will be able to apply his/her knowledge of electricity to a complex system.

18G ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Design the complete electrical system--sensors, lighting, motor controls, warning signals, etc.		Electricity 1. Photocell gates 2. Pressure sensitive switches 3. Relays 4. Motors	Electrical Engineering	

OBJECTIVE: The student will be able to estimate construction costs.

18H ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Determine the total cost of the chosen design--materials, labor, etc. Each subgroup should submit an itemized budget of materials to the I.E. group.			All Engineering Industrial Engineering	Budget Preparation Construction Estimation

OBJECTIVE: The student will become aware of the complex relationships in the environment.

18I ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Draw-Bridge Develop an environmental impact statement for the bridge.			All Engineering	E.P.A.

OBJECTIVE: The student will be able to apply the concepts of time and motion study to a routine household task.

19 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Do a motion and time study of a routine activity in the house.		Engineering Science 1. Time Study 2. Motion Study	Industrial Engineering Manufacturing Engineer Quality Control Engineering	

OBJECTIVE: The student will become familiar with the official governement description of his/her current career choice.

20 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Have the students examine the Dictionary of Occupational Titles to find out what it says about his/her current career choice. Also investigate three or four associated occupations. The studen should submit a written report of his/her findings.			All Engineering	D.O.T.

OBJECTIVE: The student will become aware of his/her personal values.

21 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
The teacher should conduct value clarification exercises with the class every two or three weeks. Values Clarification by Sidney B. Simon, Leland W. Howe, and Howard Kirchenbaum would be a good source.			All Engineering	Personal Values Sources of Values Norms Socialization

OBJECTIVE: The students will increase their vocational interest self-awareness.

22 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
The student should take the Strong Vocational Interest Survey.	Statistics Correlation Statistical Significance Percentile			Interest Survey D.O.T. Heredity Environment

me: Beginning of Junior Year and again at the end of the Senior Year.

OBJECTIVE: The student will become aware of his/her goals in life and discover means for attaining those goals.

23 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Brainstorm to list life-time goals, goals for the next 4 years, and their goals if they were going to die in three months. In addition, brainstorm to determine means to achieve each of the goals.			All Engineering	Brainstorming Goals and Means in a Life-Plan
Time: Three or four times Yearly.				

OBJECTIVE: The student will become aware of his/her self-concept.

24 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Each student should design and construct and electro-mechanical object which describes what they think of themselves				Self-Awareness Self-Concept

OBJECTIVE: The student will become aware of his/her concept of the world.

25 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
The students should design and construct an electro-mechanical object which describes the world in which they live.				Perception Self-/wareness

OBJECTIVE: The student will gain an in-depth knowledge of his/her current career choice.

26 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Have the students do extensive research into their current career choice. This should involve tasks performed, qualifications necessary, education required, relationship to Strong's Vocational Interest Survey results, monetary rewards, etc. Research should include on-site visitations and interviews.			All Engineering	D.O.T.
Time: Mid-Junior Year				

OBJECTIVE: The student will become aware of the factors which lead him/her to the current career choice.

27 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Write an autobiography of career development to date. (Donald Super's Theory of career development might be used as a guide)			All Engineering	Super's Theory of Caree Development Self-Awareness

OBJECTIVE: The student will be able to use a transit and tape to do simple surveying.

28 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Use a transit and tape to survey the school property.	Trigonometry & Geometry 1. Straight Line 2. Measuring Angles 3. Areas of Regular Polygons 4. Polar Coordinates		Civil Engineering Surveyor	Using a Transit

OBJECTIVE:

29 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit working engineers on location: 1. Manufacturing plant-mechanical and industrial. 2. Chemical plant-Chemical 3. Electrical power plant-electrical 4. Construction site-civil 5. Mine-Mining and metullurgical 6. Hospital-biomedical Time: Early in Junior Year. Visits Spread over a period of weeks.			All Engineering Disciplines	Organizational Charts History of Engineering

OBJECTIVE: The student will become aware of the similarities in the engineering skills.

30 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Write a report on the general field of engineering, stressing similarities in the various disciplines, but also pointing out differences.			All Engineering Disciplines	Report Writing
Time: Following visits to various engineers early in Junior Year.				

OBJECTIVE: 1. The student will gain an in-depth knowledge of his/her current career choice.
2. The student will be able to explain his/her career choice orally before a group.

31 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Give an oral report on a specific engineering discipline. Include information on educational requirements, certification, salary expectations, typical projects, type of employer, etc.			Specific Engineering Area of Interest to Student	Public Speaking
Time: Late in Junior Year Following extensive investigation				

OBJECTIVE: The student will become familiar with entrance requirements for his/her current career.

32 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit a school of engineering/engineering technology. Determine entrance requirements, typical programs, costs, financial aid available, etc.			All Engineering Areas Educational Opportunities	
Time: Late in Junior Year				

OBJECTIVE: The student will observe a real world application of his/her academic training.

33 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit an observatory, planetarium or satellite tracking station.			Aeronautical Engineering Optical Engineering Aerospace Engineering Electrical Engineering	

Time: Accompanying Telescope activity

OBJECTIVE: The student will see the application of his/her academic training in a real world situation.

34 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit a swimming pool builder. Discuss design considerations, construction techniques, costs, etc.			Civil Engineering Construction	

Time: Accompanying Swimming Pool Activity

OBJECTIVE: The student will observe a working refinery.

35 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit a petroleum refinery.		Chemistry 1. Hydrocarbons 2. Phase Changes	Chemical Engineering Petroleum Engineering Mechanical Engineering	OSHA Regulations E.P.A. Regulations

Time: To accompany Refining Techniques activity

OBJECTIVE: The student will observe an automotive test facility.

36 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit an automobile test facility.			Automotive Engineering Environmental Engineering	

Time: Accompanying Auto Emissions activity

OBJECTIVE: The student will observe a working power plant.

37 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit a fossil fuel power plant.			Chemical Engineering Electrical Power Engineering	

Time: Accompanying Fossil Fuel Plant activity

OBJECTIVE: The student will observe an operating neclear power plant.

38 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit a nuclear power plant.			Nuclear Engineering Electrical Power Engineering	NRC Regulations Rate Structures

Time: Accompanying Nuclear Power Plant activity

OBJECTIVE: The student will observe an operating metal processing facility.

39 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Visit a steel mill or similar facility.			Metullurgical Engineering Chemical Engineering	

Time: Accompanying Metals activity

OBJECTIVE: The student will gain an understanding of hydrogen as a fuel.

40 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Construct a hydrogen gas generator. Investigate the possibility of using hydrogen as a fuel in place of natural gas. (Scientific American and Physics Today would be good sources)		Chemistry 1. Electrolysis of Water 2. Hydrogen 3. Heat of Combustion Physics 1. Gas Laws	Chemical Engineering	Energy Economics

OBJECTIVE: The student will be able to apply his/her knowledge of physics and chemistry to a practical problem.

41 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Construct a sea-water desalinator.		Chemistry 1. Water 2. Solubility 3. Salts Physics 1. Heat of Vaporization	Chemical Engineering Environmental Engineering	Compositioning of Sea-Water

OBJECTIVE: The student will become aware of the computer as a tool in performing repetitive calculations.

42 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Write a computer program to solve an engineering problem involving many calculations. (This activity assumes the availability of access to a computer or time-share facility). Time: Early in Junior Year	Computer Programming 1. Levels of computer language 2. Elements of simple higher level language such as BASIC,FORTRAN,etc.		All Engineering	Computer Structure History of Computing

OBJECTIVE: The student will become aware of the possibility of (and associated probabilities of) extraterrestrial life.

43 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Investigate and report on the bio-engineering problem associated with detecting the presence of "life" on extraterrestrial objects.	Probability and Statistics 1. Probability 2. Descriptive Statistics	Chemistry 1. Carbon 2. Hydrocarbons 3. Organic Compounds Physics 1. Dynamics 2. Orbital Mechanics 3. Speed of Light Biology 1. What Constitutes Life? 2. Non-Carbon Based Life Systems 3. Evolution	Bio-Engineering Astronautical Engineering	Science Fiction Literature

OBJECTIVE: The student will become aware of the possibility of establishing extraterrestrial colonies.

44

ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Report on various plans for establishing extra-terrestrial colonies. The activity might include constructing a model of such a colony - either a land based or an orbitting colony.		Physics 1. Orbital Mechanics 2. Centripetal Force	Aerospace Engineering	Science Fiction Literature

OBJECTIVE: The student will become very familiar with the engineering area of his/her choice through on-the-job experience.

46 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
The student should work in an engineering office or department in a local industry or governmental unit. The work experience should involve no less than four separate situations involving the engineering area of particular interest to the student. Time: Weekly During the Senior Year			The engineering area of particular interest to the student.	

OBJECTIVE: The student will become aware of the difficulties involved in controlling pollution.

45 ACTIVITY	CONTENT			
	MATHEMATICS	SCIENCE	CAREER INVESTIGATION	ADDITIONAL TOPICS
Report on various techniques for reducing emissions from automobiles - include the catalytic converter, changes in engine design, etc.		Chemistry 1. Combustion 2. Catalysts 3. Chemical Kinetics	Chemical Engineering Automotive Engineering Environmental Engineering	

Time: Accompanying the Auto Emissions Sampling activity.